2nd European Conference on *Xylella fastidiosa*

Spatio-temporal monitoring of *Xf* in olive trees using RTM and S2 images

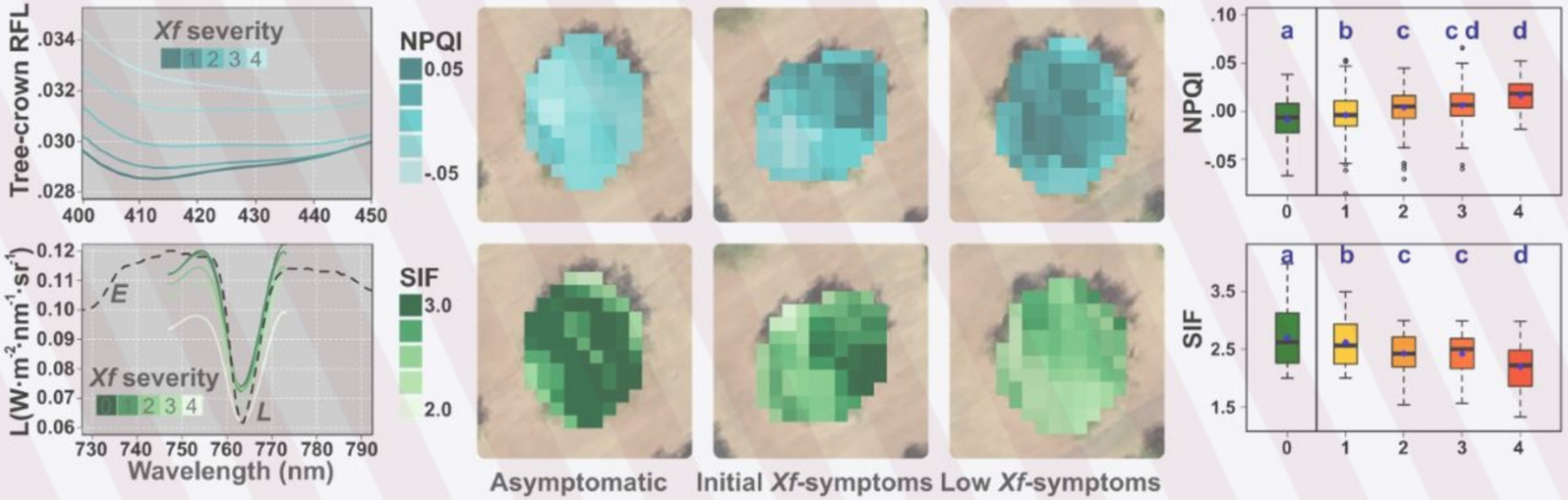
Alberto Hornero
Swansea University

Swansea University
Prifysgol Abertawe

College of Science
Coleg Gwyddoniaeth

background

Previsual symptoms of *Xylella fastidiosa* infection revealed in spectral plant-trait alterations

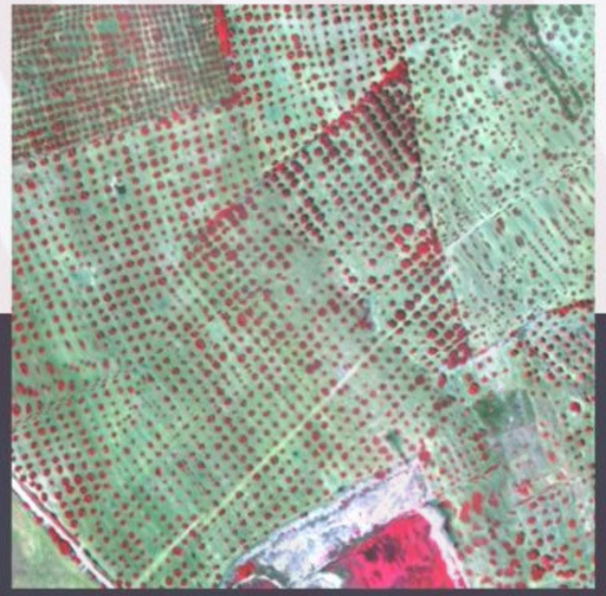


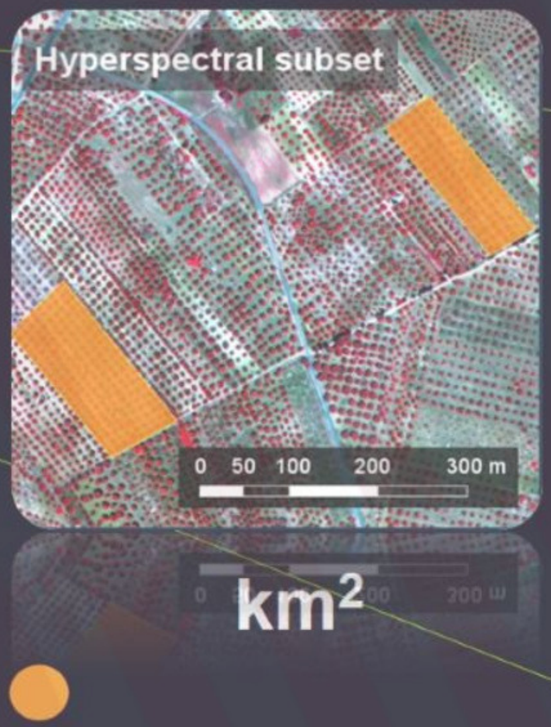
how using airborne high-resolution hyperspectral and thermal images can reveal *Xylella fastidiosa* infection in olive trees before symptoms are visible

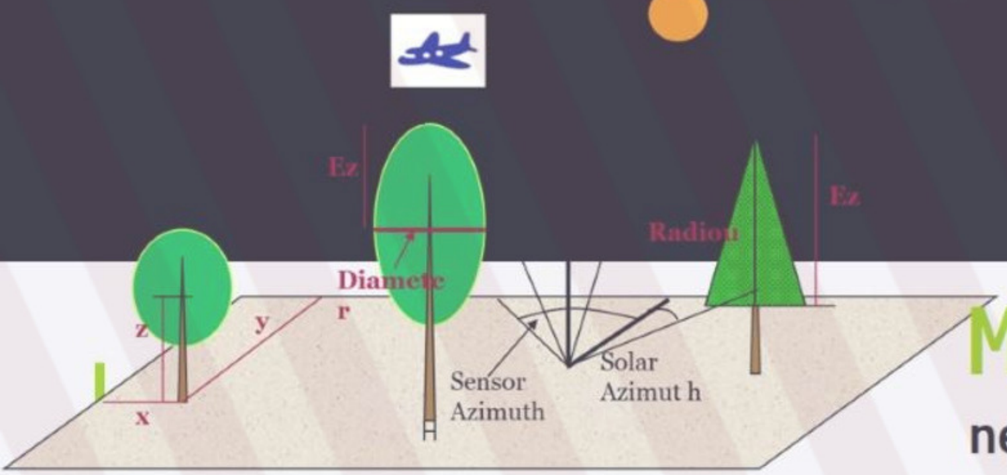
Zarco-Tejada et al., Nature Plants (2018)

background

Modelling spatial and temporal changes at the global scale





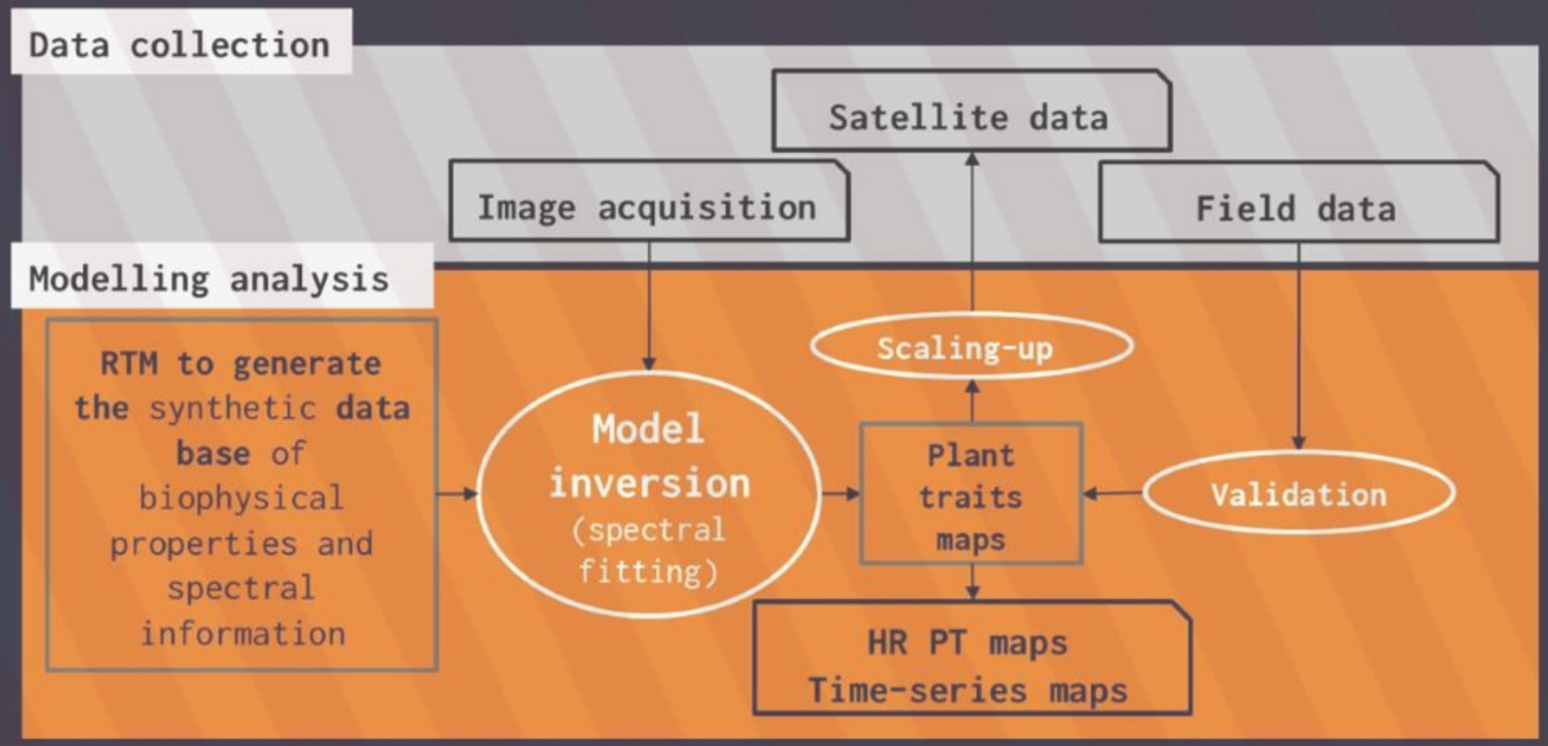


Modelling approaches are needed to quantify vegetation properties at global scale!!!

Methodology proposed

Monitoring *Xylella fastidiosa* infection from space

- Sentinel-2 time-series to describe temporal dynamics in olive groves
- Visual measurements in the field + high-resolution hyperspectral imagery for data validation



1. Study site & field data collection
2. S2 & airborne hyperspectral imagery
3. Model simulation analysis
4. Results
5. Conclusions

Hornero et al., Remote Sensing of Environment (*accepted*)

Study site and field data collection

- x16 olive orchards in Apulia (Italy)

- +3300 trees were surveyed each year. June 2016 + July 2017

- 5 severity levels based on a visual inspection, binary classified as incidence

- 2016: 50% of trees without symptoms
- 2017: 85% of trees with symptoms

- Relative increase expressed as ΔDS and ΔDI

$$\Delta DS = (DS_{2017} - DS_{2016}) / DS_{2016}$$
$$\Delta DI = (DI_{2017} - DI_{2016}) / DI_{2016}$$

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Sentinel-2A and airborne hyperspectral imagery

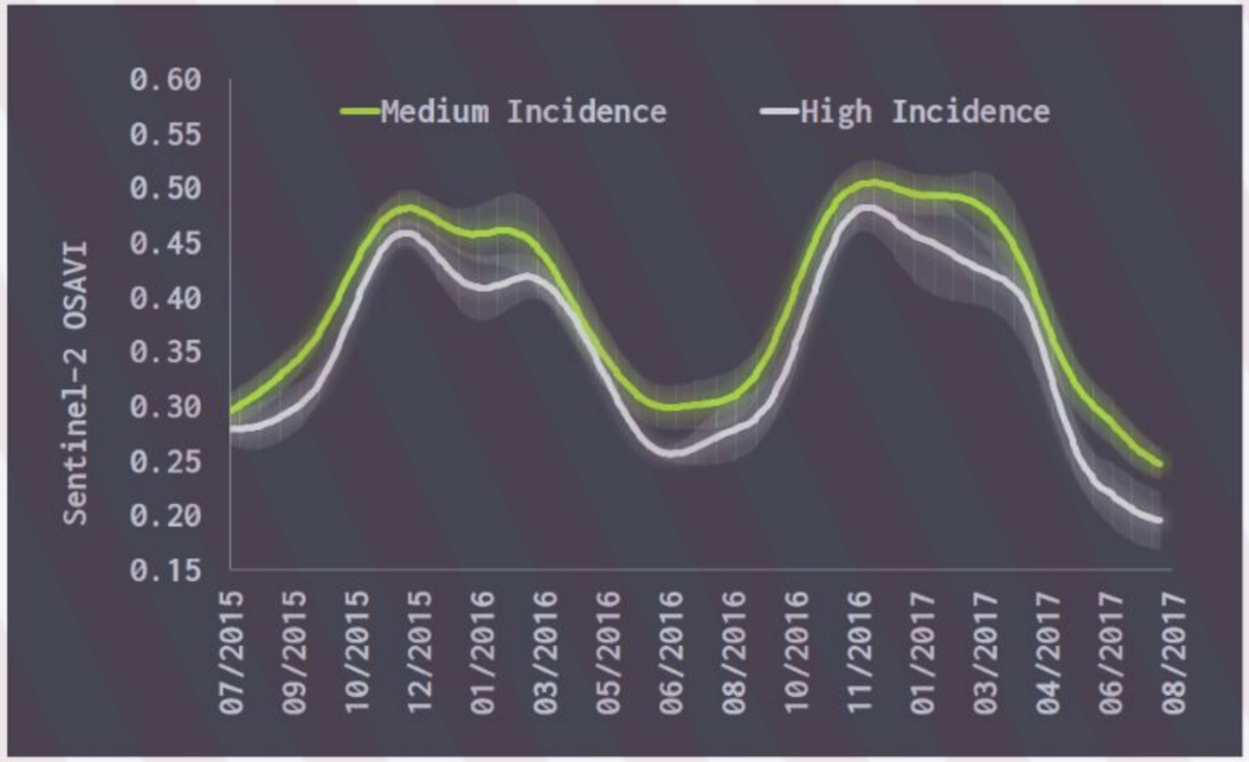
- Two-year daily Sentinel-2 time-series atmospherically corrected

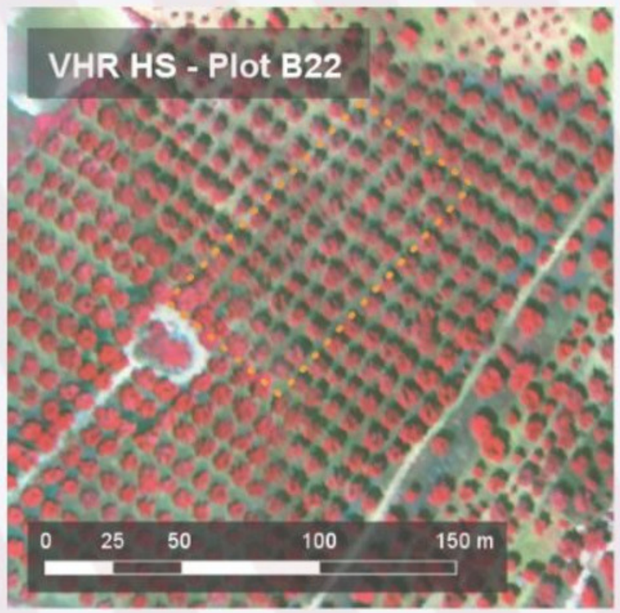
- VI compatible with S2 spectral bands

- Temporal variation ratio for VI

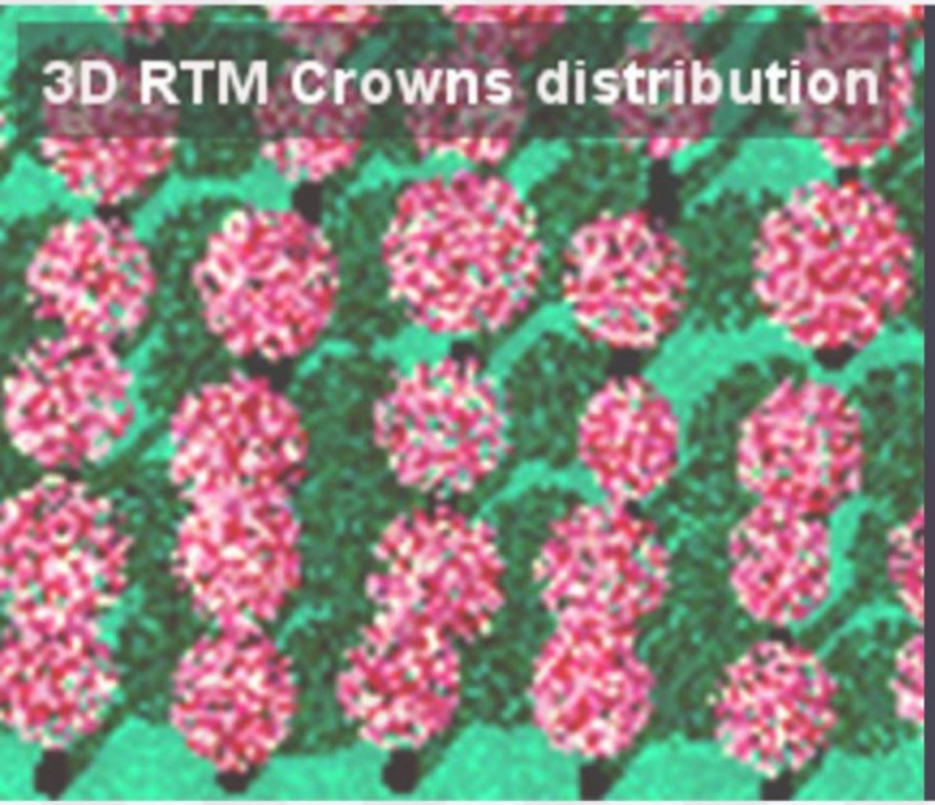
- Pearson correlation analysis with ΔDS/ΔDI

- VHR-HS @ 40 cm/px for: validation
  model parametrisation



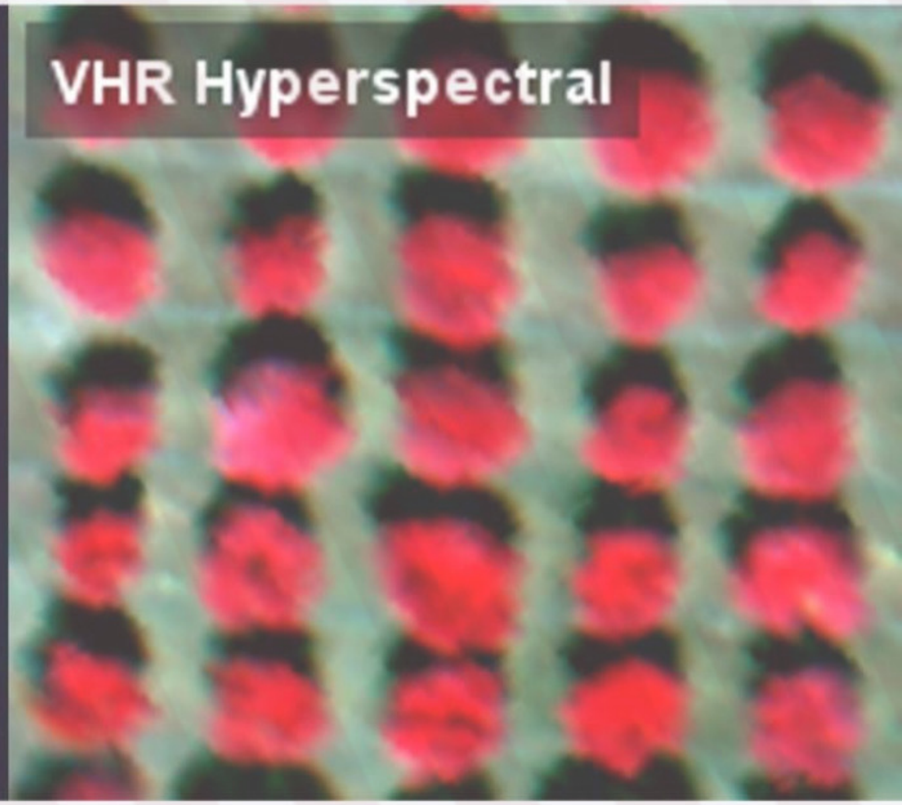


Model simulation analysis



PROSPECT + FLIGHT

- PROSPECT leaf model
- FLIGHT 3D RTM
- +7K simulations
- LUT classified through FC
- Variation year to year



3 different strategies

- Temporal Background per Plot **TBP**
- Mean Temporal Background **MTB**
- Persistent Background **PB**

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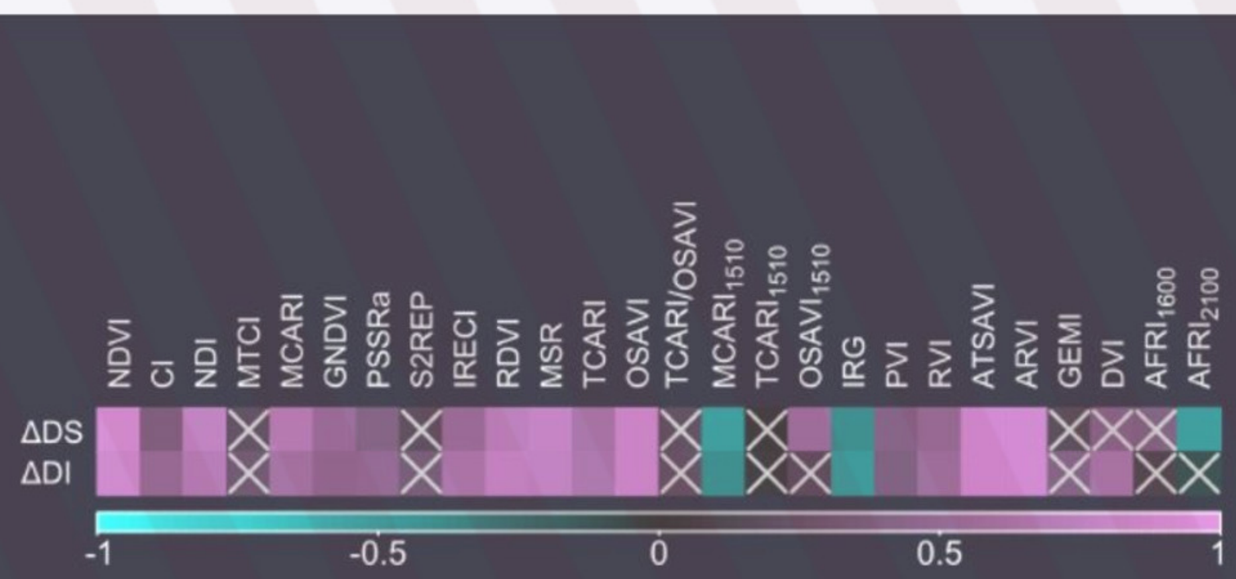
Results

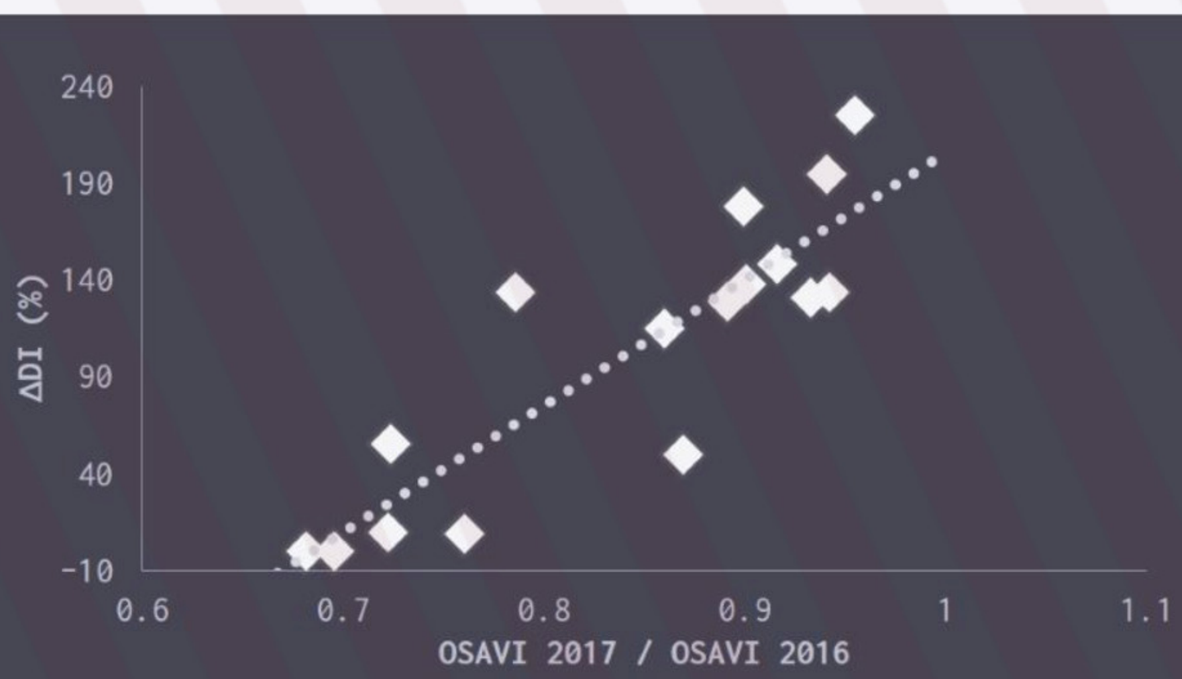
Temporal trends and VI

$r^2_{ARVI} = 0.75$ $r^2_{OSAVI} = 0.76$ ~ ΔDI

$r^2_{ARVI} = 0.74$ $r^2_{OSAVI} = 0.71$ ~ ΔDS

↗ ΔDI ≈ ↘ VI ~ background effect





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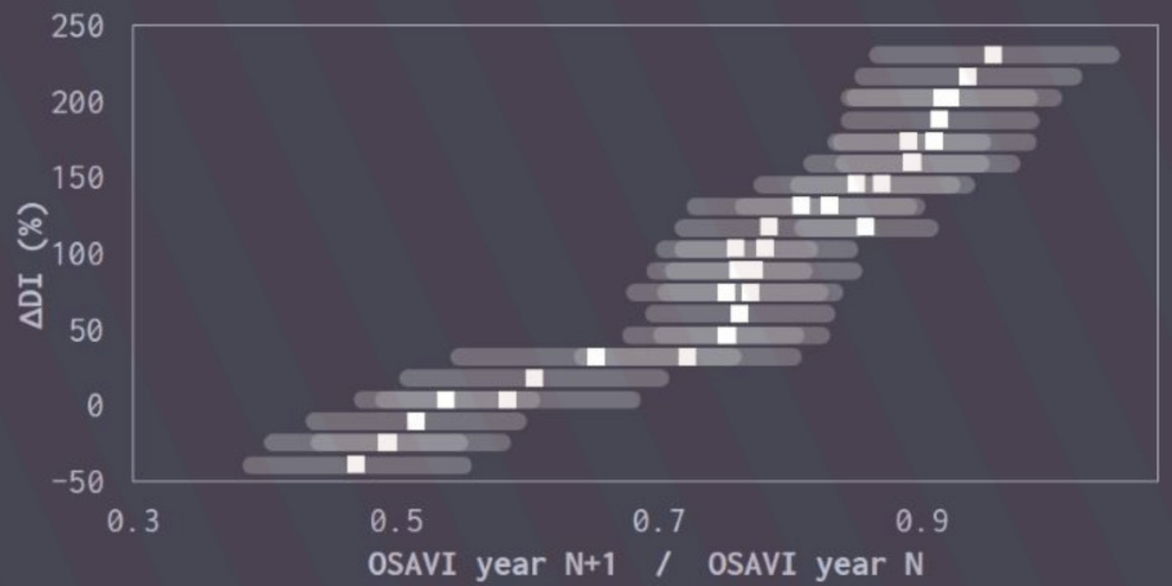
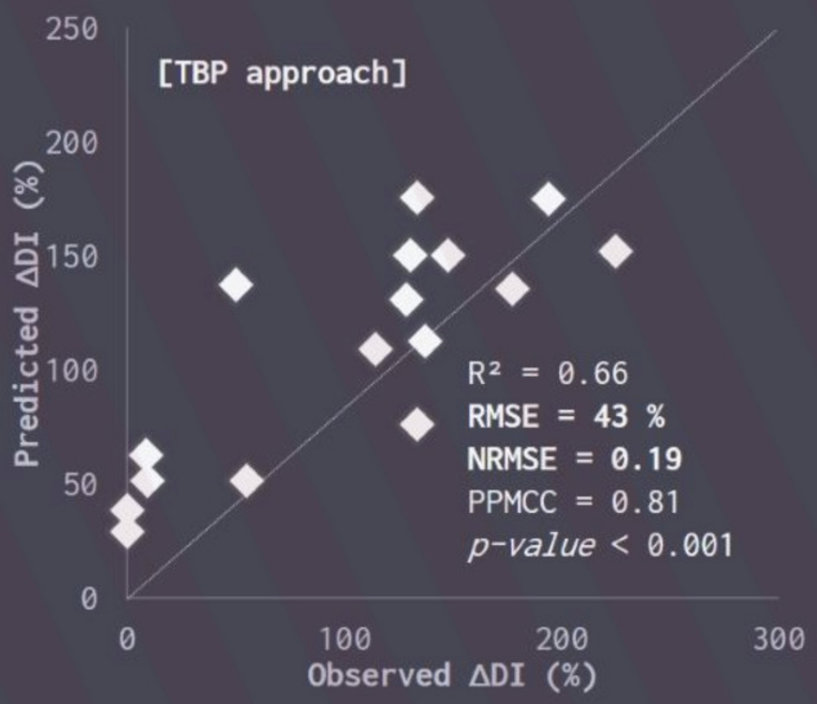
Results

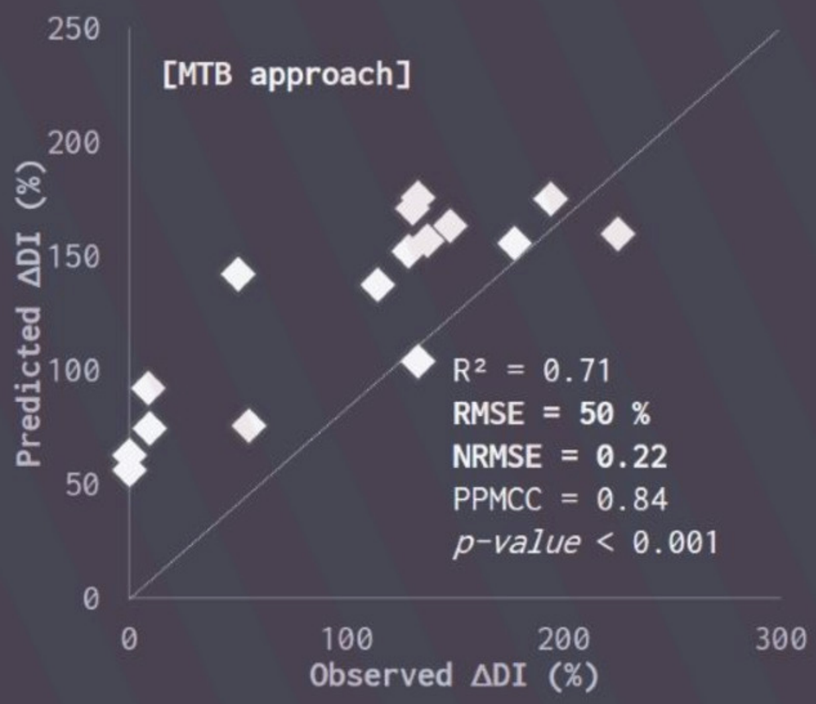
Modelling changes in vegetation trends with Sentinel-2

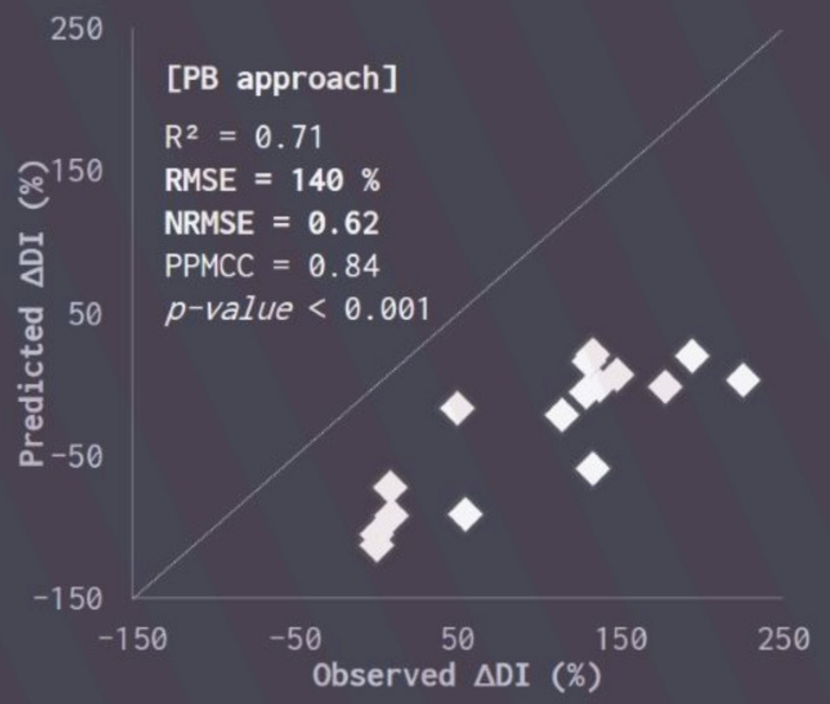
- Background effects have a significant impact on the temporal variation of the incidence

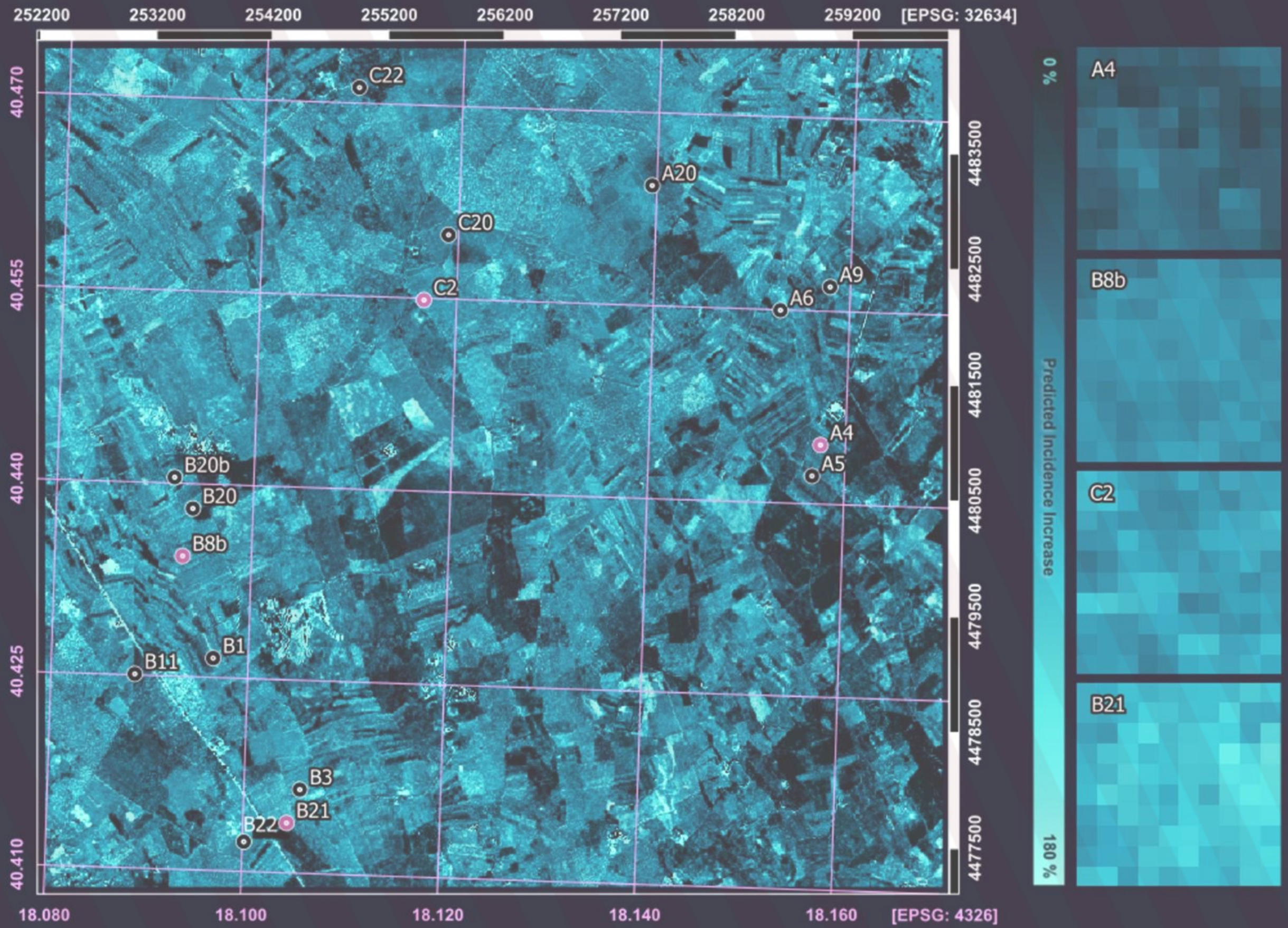
- RTM improved the estimates by
  - 25% MTB approach
  - 32% TBP approach











Map of the predicted increase in Xf-symptom incidence between 29th June 2016 and 24th June 2017

Conclusions

- Sentinel-2 successfully detected temporal changes in the incidence of Xf infection

- Atmospheric and soil-corrected indices performed better than traditional formulations

- Background has an enormous impact on the vegetation indices

- This work demonstrates the benefit of combining model simulations and Sentinel-2 data

Thank you